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(54) Optical fibre splices and terminations

(57) To make an optical fibre splice the two fibres to be spliced have the claddings removed from their ends, which are fitted into opposite ends of a tunnel between two blocks of a fluorinated or perfluorinated carbon polymer of co-polymer. This tunnel is defined by two grooves one in each block.

The whole is clamped together so that at the splice region the cladding is replaced by the polymer or co-polymer, which also performs a light-guiding function in respect of light in the fibres.

The idea is also applicable to optical fibre terminations, and one is described in which the fibre is secured in a jewel-ended ferrule by a fused billet of the polymer or co-polymer.

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Fig. 1.

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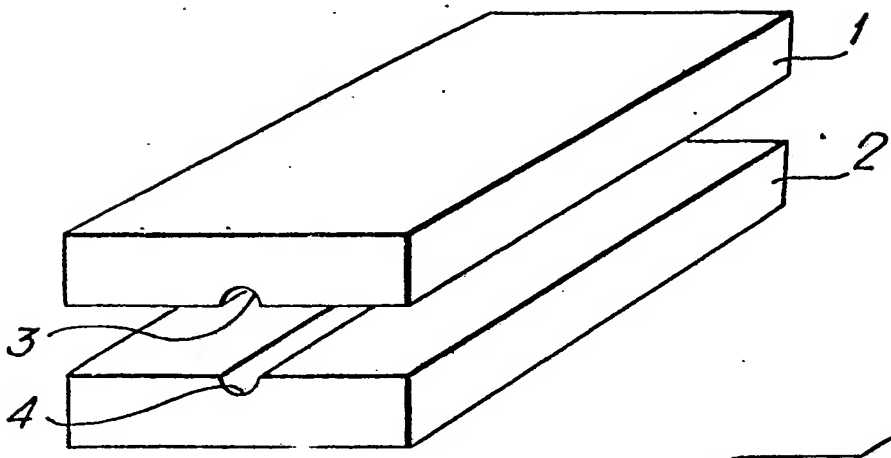


Fig. 2.

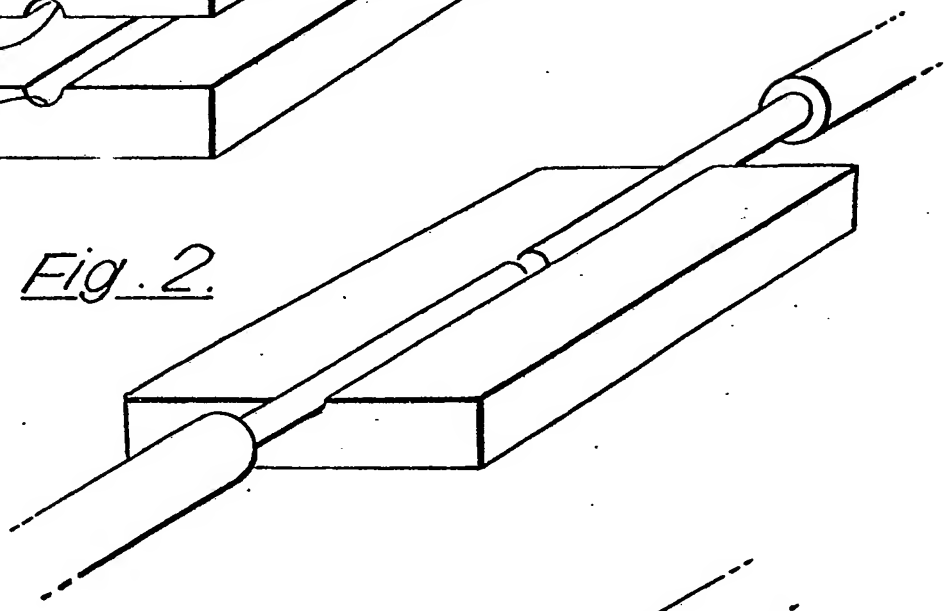


Fig. 3.

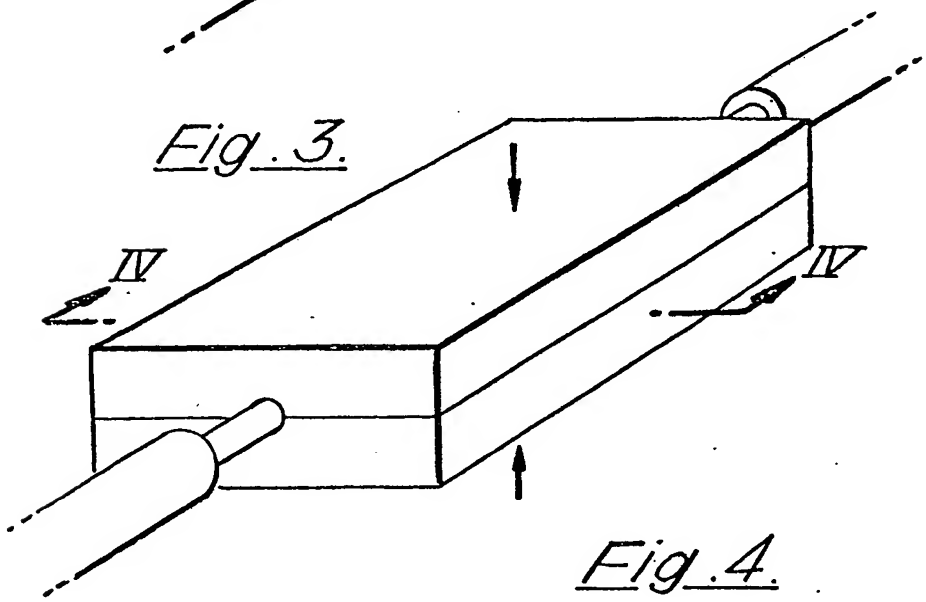
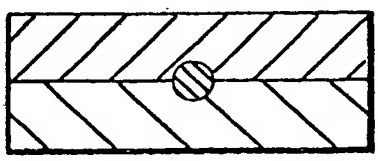


Fig. 4.



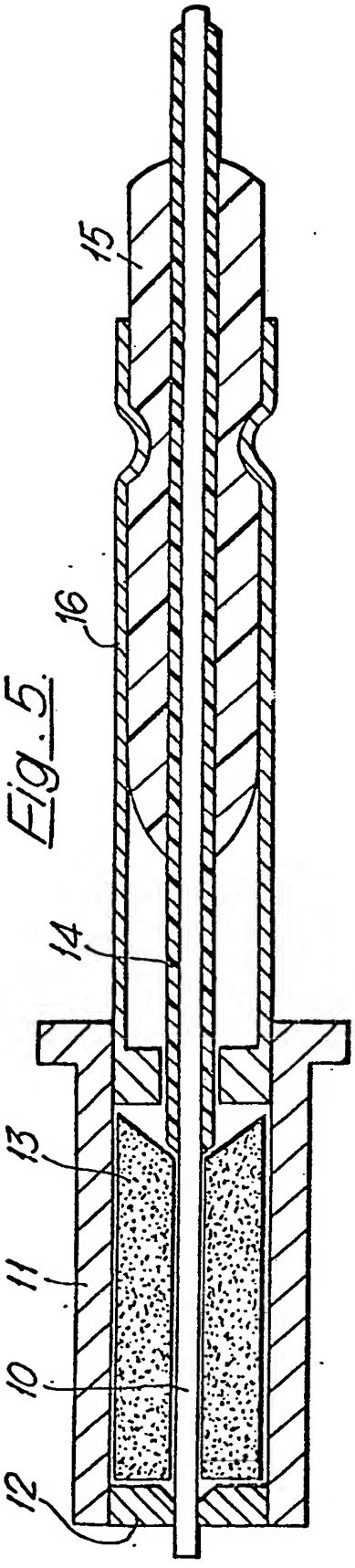


Fig. 5.

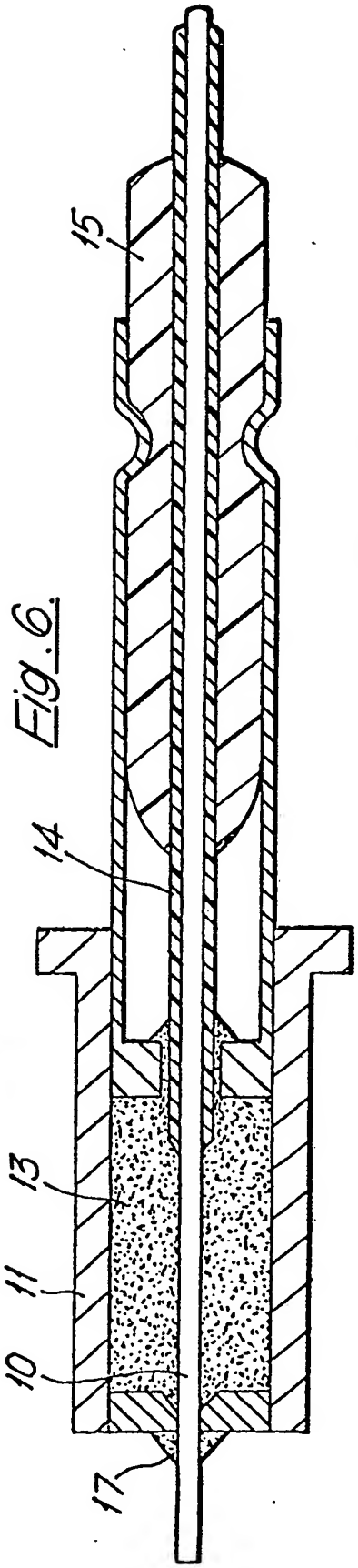


Fig. 6.

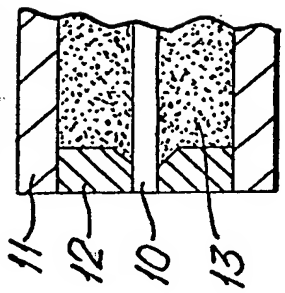


Fig. 7.

SPECIFICATION

Optical fibre splices and terminations

The present invention relates to optical fibre splices, and especially to such splices which are intended for use in "field" conditions, and to optical fibre terminations.

The production of such splices is to some extent hampered by the low mechanical strength of the claddings usually used for optical fibres. In addition such claddings often have poor adhesion qualites. Such disadvantages are exemplified in the silicone resin often used as cladding material, especially for fused silica optical fibres. Similar considerations tend to apply in the case of optical fibre terminations, such as are used in demountable connectors.

An object of the invention is to provide a simple and economical fibre splice or termination.

According to the invention there is provided a method of making a splice between the ends of two optical fibres, or a termination for an optical fibre, in which the claddings in the region of the fibre ends in the case of the splice or the cladding in the region of the fibre end in the case of the termination is removed and replaced by a fluorinated or perfluorinated carbon poiymer or copolymer, in which the material chosen for the replacement is such as to perform a light-guiding function in respect of light negotiating the fibres or the fibre, and in which the replacement material retains the fibres or the fibre in place.

According to the present invention there is also provided a method of making a splice between the ends of two optical fibres, in which the cladding in the region of the fibre ends is removed, in which the unclad regions of the ends of the fibres are located in a cylindrical tunnel formed by two aligned semicircular grooves formed in the plane surface of two members fitted together, in which said two members are made from a fluorinated or perfluorinated carbon polymer of co-polymer so that the cladding of the end regions of the fibres to be spliced are replaced by said polymer or co-polymer, in which the said replacement material is such that it performs a light-guiding function in respect of light negotiating the optical fibres, and in whcih the members of said polymer or co-polymer are clamped or otherwise secured together to retain the fibre ends firmly in place and in juxtaposed relationship.

According to the present invention there is provided a method of making a termination for an optical fibre in which a substantially cylindrical pierced billet of a fluorinated or perfluorinated carbon polymer or co-polymer is inserted into a tubular ferrule having one end closed by a perforated jewel, in which the cladding in the region of the fibre end is removed, in which an extension tube is crimped to the outer surface of the outer cladding of the fibre such that the unclad end of the fibre projects from the end of the tube, in which the fibre end is inserted into the hole in the billet and into the jewel, where, after the ferrule is heated to melt the material of the billet, in which while the billet is molten the fibre and extension tube are pushed inwards of the ferrule so that the molten material of the billet fills the ferrule and may even exude via the clearance between the fibre and the jewel hole, and in which the whole is allowed to cool down so that the material of the billet as it solidifies holds the fibre in place, and in which after the solidification the end of the fibre is polished off so as to be flush with the jewel end.

An embodiment of the invention will now be described with reference to the attached drawings, in which:—

Fig. 1 shows two blocks of a fluorinated carbon polymer or co-polymer used to make an optical fibre termination.

Fig. 2 shows one of the blocks of Fig. 1 with two suitably prepared optical fibres in position.

Fig. 3 shows the termination with the second block in position.

Fig. 4 is a cross section taken at IV—IV of Fig. 3.

Figs. 5 and 6 are sectioned viewed of an optical fibre termination embodying the invention.

Fig. 7 is a "scrap" view of the end of the termination of Figs. 5 and 6 in its final condition.

The family of fluorinated and perfluorinated polymers and co-polymers used in the arrangement to be described herein, which include a fluorinated ethylene polymer sold under the Registered Trade Mark TEFLON FEP, have low refractive indices, typicall 1.33 to 1.42 and are relatively transparent, e.g. loss of the order of 5dB/cm. This qualifies them for use as a cladding medium for fused silica, which has a refractive index of about 1.45 especially when the medium is used in short lengths, as in the case for optical splices and terminations. These materials also exhibit high mechanical strength and chemical inertness, and remain stable over a wide temperature range, typically from less than —50°C to more than 200°C.

A splice made using the principles of this invention will now be described with reference to the drawing, the material used being that sold under the Registered Trade Mark TEFLON FEP. The two blocks 1 and 2 have semicircular grooves 3 and 4 in their surfaces, the two grooves being of similar sizes, such that when the blocks are placed together the pair of grooves forms a tunnel in which a stripped fibre is a snug fit.

One convenient method of making these grooves is to clamp the blocks together over a continuous length of optical fibre core, in which case the grooves are "embossed" so as to have the required dimensions. This "embossment" is effective since the fibre core is harder than the material used for the blocks.

The blocks shown in Fig. 1 and the other figures relate to a splice for a single optical fibre, but where several splices have to be made, separate grooves are provided on the two blocks.

To splice two fibres, the cleaved and stripped fibres are fitted into the groove in one block as shown in Fig. 2, with or without a drop of an

index-matching fluid medium between them. Then the other block is placed over the first block, and the resulting outer protective covering (not shown) is placed over the arrangement shown in Fig. 3.

In the case of a termination one produces what is in effect half of what is is shown in the drawing, the or each fibre to be terminated being retained in a tunnel in a manner similar to what is shown.

Note that the materials used are so chosen as to have a light-guiding function for light in the fibres.

In the termination for an optical fibre which is shown in Fig. 5, the fibre 10 is terminated in a ferrule 11 with a jewel 12 at its end. Within this ferrule there is a premoulded plastics billet 13, which is pierced so as to receive the fibre end, and is of fluoroplastics material such as already mentioned. As before, the fibre is prepared by having both its (usually silicone) primary cladding 14 and its secondary thermoplastics coatng 15 removed, as shown in Fig. 5, whereafter the fibre is fitted through the billet 13 and jewel 12, so that its end projects slightly, as shown.

The fibre is within an extension tube 16 with one end closed except for a hole of suitable size to take the fibre core with its cladding 1 and coating 15 removed. This tube is counter-bored as shown to act as a "moulding ram" in the second stage of the process, and the components are assembled as shown in Fig. 5. The tube is also crimped to the coating 15, as shown.

The ferrule 11 is now heated to the softening point of the billet 13, e.g. about 350°C for TEFLON FEP (Registered Trade Mark), and the extension tube pushed further into the ferrule. Thus the tube 16 in this stage acts as a "moulding ram" to completely fill the ferrule with the fused fluoroplastics. In this process some of the material of the billet 13 is extruded through the clearance between the fibre core and the jewel hole, as indicated at 17.

The assembly is now allowed to cool down to ambient temperature and the protruding fibre end is polished back to be flush with end of the jewel, as can be seen in Fig. 7. In this, the "sprue" of plastics formed at 17, Fig. 6, is also removed.

The above operations can be performed by a special tool, which for operation "in the field" could be a hand tool.

CLAIMS

1. A method of making a splice between the ends of two optical fibres, or a termination for an optical fibre, in which the claddings in the region of the fibre ends in the case of the splice or the cladding in the region of the fibre end in the case of the termination is removed and replaced by a fluorinated or perfluorinated carbon polymer or co-polymer, in which the material chosen for the replacement is such as to perform a light-guiding function in respect of light negotiating the fibres or fibre, and in which the replacement material retains the fibres or the fibre in place.

2. A method of making a termination as claimed in claim 1, in which the polymer or co-polymer is formed as a pair of members each of which is formed with a semi-cylindrical groove, and in which the two semi-cylindrical grooves are so dimensioned that when the members are fitted together the grooves together define a cylindrical tunnel within which a fibre end to be terminated is retained.

3. A method of making a splice as claimed in claim 1, in which the polymer or co-polymer is formed as a pair of members each of which is formed with a semicylindrical groove, and in which the two semicylindrical grooves are so dimensioned that when the members are fitted together the grooves together define a cylindrical tunnel within which the ends of the two fibres to be spliced are snugly retained in on end-on abutting relation.

4. A method of making a splice between ends of two optical fibres, in which the cladding in the region of the fibre ends is removed, in which the unclad regions of the ends of the fibres are located in a cylindrical tunnel formed by two aligned semi-circular grooves formed in the plane surface of two members fitted together, in which said two members are made from a fluorinated or perfluorinated carbon polymer or copolymer so that the claddings of the end regions of the fibres to be spliced are replaced by said polymer or copolymer, in which the said replacement material is such that it performs a light-guiding function in respect of light negotiatng the optical fibres, and in which the members of said polymer or copolymer are clamped or otherwise secured together to retain the fibre ends firmly in place and in juxtaposed relationship.

5. A method as claimed in claim 3 or 4, and in which a drop of an index-matching medium is located between the aligned ends of the two fibres to be spliced.

6. A method of making an optical fibre splice or termination substantially as described with reference to the accompanying drawing.

7. An optical fibre splice or termination made by the method of any one of claims 1 to 6.

8. An optical fibre splice which includes two members each of which has a flat face with a semi-circular groove in that flat face, the grooves being so dimensioned that when the members are fitted together the two grooves together define a cylindrical tunnel within which the ends of the two fibres to be joined fit snugly after the fibres have had their claddings removed, and two optical fibres from the end regions of which the claddings have been removed, which fibres extend into the tunnel from opposite ends until their ends are closely to each other with the two fibre ends axially aligned in which the two members are made of a fluorinated or perfluorinated carbon polymer or copolymer whose characteristics are such that it provides a light-guiding function in respect of light negotiating in the fibres, and in which after the fibre ends have been received in the tunnel the two members are clamped or otherwise secured together, a protective outer coating is placed over the said members and the adjacent portion of the

fibres.

9. A splice as claimed in claim 8, and in which the semicircular grooves are made by clamping the fibres over a continuous fibre core.

10. A method of making a termination for an optical fibre in which a substantially cylindrical pierced billet of a fluorinated or perfluorinated carbon polymer or copolymer is inserted into a tubular ferrule having one end closed by a perforated jewel, in which the cladding in the region of the fibre end is removed, in which an extension tube is crimped to the outer surface of the outer cladding of the fibre such that the unclad end of the fibre projects from the end of the tube, in which the fibre end is inserted into the hole in the billet and into the jewel, whereafter the ferrule is heated to melt the material of the billet, in which while the billet is molten the fibre and extension tube are pushed inwards of the ferrule so that the molten material of the billet fills the ferrule and may even exude via the clearance between the fibre and the jewel hole, and in which the whole is allowed to cool down so that the material of the billet as it solidifies holds the fibre in place, and in which after the solidification the end of the fibre is polished off so as to be flush with the jewel end.

11. An optical fibre termination made by the method of claim 10.

12. An optical fibre termination substantially as described with refrence to Figs. 5, 6 and 7 of the accompanying drawings.

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